APPENDIX D - METHOD FOR ESTIMATING "n" VALUES

The following is a procedure that may be used in estimating "n" values to be used in open-channel hydraulic computations. The procedure is discussed in further detail in reference 8, and involves selecting a basic value and then, through a series of steps, modifying the value to account for irregularity, variation in size, obstructions, vegetation, and meander.

Step 1. Selection of the basic n value (n_1) for a straight, uniform, smooth channel. The basic n value is determined based only on the materials forming the channel.

Channel material	Basic n
Earth	0.020
Cut in rock	0.025
In fine gravel	0.024
In coarse gravel	0.028

Step 2. Selection of modifying value for surface irregularity (n_2). The selection is based on the degree of roughness or irregularity of the surfaces of channel sides and bottom.

Degree of irregularity	Surfaces comparable to	Modify value
Smooth	The best obtainable for the materials involved.	**0.00**
Minor	Good dredged channels; slightly eroded or scoured side slopes of canals or drainage channels.	**0.01**
Moderate	Fair to poor dredged channels; moderately sloughed or eroded side slopes.	**0.01**
Severe	Badly sloughed banks of natural channels; unshaped, jagged and irregular surfaces of channels excavated in rock.	**0.02**

(Source: "Guide for Selecting Roughness Coefficient "n" Values For Channels," USDA, Soil Conservation Service, December 1963, and Reference 8)

Step 3. Selection of modifying value for variations in shape and size of cross sections (n_3). Shape changes causing the greatest turbulence are those in which the main flow shifts from side to side in short distances.

Character of variation in size and shape of cross sections
Modifying value

Changes in size or shape occurring gradually	**0.000**
Large and small sections alternating occasionally or shape changes causing occasional shifting of main flow from side to side	**0.005**
Large and small sections alternating frequently or shape changes causing frequently or shape changes causing frequent shifting of main flow from side to side	**0.010** to **0.015**

Step 4. Selection of modifying value for obstructions (n_4). Based on the presence of obstructions such as debris, stumps, boulders, and logs.

Relative effect of obstructions	**~~Modifying value~~**
Negligible	0.000
Minor	0.010 to 0.015
Appreciable	0.020 to 0.030
Severe	0.040 to 0.060

Step 5. Selection of modifying value for vegetation (n_5).

Vegetation and flow conditions comparable to:	**Degree of effect on n**	**Range in modifying value**
Dense growths of flexible turf grasses, where the average depth of flow is 2 to 3 times the height of vegetation.	Low	**0.005** to **0.010**
Turf Grasses where the average depth of flow is 1 to 2 times the height of vegetation. Stemmy grasses, weeds or tree seedlings with moderate cover where the average depth of flow is 2 to 3 times the height of vegetation. Brushy growths, moderately dense, along side slopes of channel, little vegetation along the channel bottom.	Medium	**0.010** to **0.025**
Turf grasses where the average depth of flow is about equal to the height of vegetation. Dormant season, willow or cottonwood trees 8 to 10 years old, inter-grown with some weeds and brush, no vegetation is in foliage. Growing season, some weeds in full foliage along side slopes, little vegetation along the channel bottom.	High	**0.050** to **0.100**
Turf grasses where depth of flow is less than one half the height of vegetation. Growing season, weeds and brush in full foliage along side slopes; dense growth of cattails along channel bottom.	Very high	**0.050** to **0.100**

Step 6. Determination of the modifying value for meandering of channel (n_6). The value is multiplied by the sum total of the basic n value and the modifying values determined in steps 1 through 5.

Ratio lm/ls	Degree of meandering	Modifying value
1.0 to 1.2	Minor	0
1.2 to 1.5	Appreciable	0.15 n_s
1.5 and greater	Severe	0.30 n_s

where: l_m - the meander length of the reach
l_s - the straight length of the channel in the reach
n_s - sum of steps 1 through 5 ($n_1+n_2+n_3+n_4+n_5$)

Step 7. Add all of the values together to obtain the n value for the reach.

Computed n value = ($n_1+n_2+n_3+n_4+n_5+n_6$)

Example estimation of "n" value

(1)	channel in earth	0.020
(2)	banks moderately sloughed	0.010
(3)	gradual size changes	0.000
(4)	Minor obstructions	0.010
(5)	Low vegetation	0.005
	subtotal (ns)	0.045
(6)	Appreciable meander (.15ns)	0.007
	computed n value	**0.052**